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Model of Factors Influencing Waste Management in Phuket

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ABSTRACT

The objective of this research was to study the factors that directly and indirectly influence waste management in Phuket province. Data from questionnaires distributed to 400 households were analyzed applying the Structural Equation Model (SEM) by using Partial Least Square (PLS). Research findings show that the influence of waste disposal behavior, people's participation and technology utilization are statistically significant at 0.01. Thus, it can be concluded that more attention needs to be paid to people's participation, waste disposal behavior and technology utilization by both the local government and the people of Phuket to establish a sustainable waste management system.

Key words: People's participation, waste disposal behavior, technology utilization, waste management, sustainable waste management system

INTRODUCTION

Economic and population growth have led to the expansion of urban cities and higher standards of living. These factors, in turn, have led to increased volume of waste especially in developing countries (Minghua *et al*., 2009) with local governments taking responsibility of waste management in their respective cities. However, these local governments often discover that they have inadequate resources to deal with the issues that arise (Sujauddin *et al*., 2008), particularly budgetary issues (Burnley, 2007). Such is the case with a bustling metropolis like Phuket.

Phuket is Thailand's largest island, comprising three districts which are Muang, Kathu and Thalang District. The 2007 national census stated the province's population at 315,498. As of September 2011 Phuket's population was 351,909 or 186,848 households showing an increase of 2.75% (www.phuket.go.th/phuket_poc/report/sar/support_management.php). In 2007, waste in Phuket province averaged 513 tons per day. In 2011, it increased to 548 tons per day or an increase of 7% (Waste disposal center, Phuket municipality). The growth in the population led to increased volume of waste which is a crucial environmental issue (Pitt *et al*., 2002).

Waste pollution has become an increasingly crucial issue which has led to increased interest in the field of waste management. Scholars such as Shukor *et al*. (2011) and Bortoleto and Hanaki (2007), have studied the influenced people's participation has on waste management. Swami *et al*. (2011), Nishio and Takeuchi (2005), Nonami *et al*. (1997) and Taylor and Todd (1995b) have studied the effects of waste disposal behavior on waste management while Kurz *et al*. (2007) and Gamba and Oskamp (1994) have studied the influence of waste disposal behavior through people's participation. Bartelings and Sterner (1999) and Taylor and Todd (1995a, 1997) studied the

influence of waste disposal behavior through technology utilization. Gentil *et al.* (2009) studied the influence of technology utilization on waste management while Toma and Mathijs (2007) studied the technology utilization that influenced people's participation through waste management. It is hypothesized that the aforementioned factors will influence waste management in Phuket province.

Thus, the researcher has studied the influence of people's participation, waste disposal behavior and technology utilization on waste management in Phuket province to help provide valuable insight to the local government responsible for the development and implementation of strategies that will lead to efficient and sustainable waste management.

Through extensive reviews of concepts, theories and research studies, the researcher set the following hypotheses for this study.

Hypothesis:

H1: Waste disposal behavior influences waste management
H2: Technology utilization influences waste management
H3: Waste disposal behavior influences people's participation
H4: Technology utilization influences people's participation
H5: Waste disposal behavior influences technology utilization
H6: People's participation influences waste management

METHODOLOGY

The purpose of this research was to study the direct and indirect influences on waste management in Phuket province. The influence people's participation, waste disposal behavior and technology utilization has on waste management in Phuket province. The study group comprised heads of households. Quantitative research was conducted for beginning with extensive literature review to help determine the parameters of the study.

Data was collected through use of a questionnaire employing a 7-point Likert scale with 1 being the lowest level and 7 the highest. The questionnaire was assessed by five specialists for content validity and adjusted accordingly as well as measuring the IOC value. It was found that each question had an IOC value greater than 0.8. A pilot study was then conducted with a sample group of 30 participants measuring the reliability of the questionnaire using Cronbach's α-coeeficient value. It was found that each variable had a value of 0.886-0.895 indicating high reliability of the questionnaire. The main survey was conducted with a group of 400 participating heads of households in Phuket. Participants in the study group were chosen by stratified random sampling into three districts of Phuket province then by simple random sampling.

Quantitative measurement

Dependent variable

Waste management: A measurement tool in the form of a questionnaire was developed to measure four primary steps; storage, transportation, processing and disposal (Tchobanoglous *et al.*, 1993).

Independent variable

Waste disposal behavior: A measurement tool in the form of a questionnaire was developed to measure the 3Rs; reduce, reuse and recycle (Maity *et al.*, 2011; Phillips *et al.*, 1999).

People's participation: A measurement tool in the form of a questionnaire was developed to measure four steps; decision making, implementation, benefits and evaluation (Ayotamuno and Gobo, 2004; Ngowi, 1997).

Technology utilization: A measurement tool in the form of a questionnaire was developed to measure landfills, incineration and composting (McDonald and Smithers, 1998).

Statistical analysis: The quantitative data were analyzed with the Partial Least Squares statistical tool. The hypotheses were validated with the PLS-Graph program (Chin, 2001). The analysis results were displayed as a model structure to determine manifest and latent variables. The measurement tools' validity and reliability were analyzed and their internal consistency was measured by Cronbach's α-coefficient. The α-coefficient was found to be between 0.886-0.895 which indicates high reliability level.

Reflective model structures were created for this study and tested for convergent validity and discriminant validity. The criteria for convergent validity are as follows; the loading value must be positive, the indicator loading values must be over 0.707 with a statistical significance of ($|t| \geq 1.96$) for all values (Lauro and Vinzi, 2004; Henseler *et al*., 2009; Piriyakul, 2010). The analysis results are shown in Table 1.

RESULTS

Prior to the evaluation of the structural model, we analyzed the measurement model to ensure that each variable was valid and reliable (Barclay *et al*., 1995). By examining the individual item loadings, it is possible to determine which items can be included in the final model and which items may need to be considered for removal. Items may be removed to avoid bias in parameter estimates in performing the structural model analysis (Hulland, 1999). But landfills, incineration and transportation, the minimum acceptable loading is generally 0.50 (Hair *et al*., 2010). Construct items are presented in Table 1 which indicates those that were retained and those removed.

Table 1: Reflective statistical values indicating convergent validity of the latent variables

Construct/item	Loading	AVE	t-stat
Behavior			
Reduce	0.8163	0.700	38.4516
Reuse	0.8472		47.9801
Recycle	0.8469		48.1455
Technology			
Landfill	0.6529	0.500	11.7736
Incineration	0.5578		9.6645
Compost	0.8624		47.3412
Participation			
Decision	0.7816	0.741	33.2138
Implement	0.8884		67.7327
Benefits	0.8708		62.4277
Evaluation	0.8976		65.4020
Waste management			
Storage	0.7478	0.546	26.7489
Transport	0.6478		15.3103
Process	0.8401		45.2979
Disposal	0.7055		20.6130

Behavior factors consisting of reduce, reuse and recycle had the loading values of 0.8163, 0.8472 and 0.8469 with a statistical significance of 95% (t-stat >1.96) which indicate that a particular factor had influence over waste management.

Technology factors consisting of landfill, incineration and compost had the loading values of 0.6529, 0.5578 and 0.8624 with a statistical significance of 95% (t-stat >1.96) which indicate that a particular factor had influence over waste management.

People's participation factors consisting of decision, implement, benefits and evaluation had the loading values of 0.7816, 0.8884, 0.8708 and 0.8976 with a statistical significance of 95% (t-stat >1.96) which indicate that a particular factor had influence over waste management.

Waste management factors consisting of storage, transport, process and disposal had the loading values of 0.7478, 0.6478, 0.8401 and 0.7055 with a statistical significance of 95% (t-stat >1.96) which indicate that a particular factor had influence over waste management.

Discriminant validity: For reliability test of the measurement tools the Composite Reliability (CR) value should not be less than 0.60, the Average Variance Extract (AVE) should not be less than 0.50, the R^2 value should not be less than 0.20 and the AVE in the interested columns must be higher than the cross construct correlation of all values in the same column in order to be considered reliable in all constructs (Lauro and Vinzi, 2004; Henseler *et al.*, 2009; Wingwon and Priryakul, 2010) (Table 2).

Analysis results of the model of influencing factors on waste management in Phuket are shown in Fig. 1.

The results of research hypotheses tests are shown in Table 3.

Hypothesis:

H1: Waste disposal behavior affects waste management. The test result found that behavior affects waste management with a coefficient of 0.439, a fact validated by the hypothesis significance $p \leq 0.01$

Table 2: Statistical values for discriminant validity of model

				Cross construct correlation			
Construct	CR	R^2	AVE	Behavior	Technology	Participation	Waste
Behavior	0.875		0.700	0.837			
Technology	0.739	0.270	0.500	0.519	0.707		
Participation	0.919	0.507	0.741	0.650	0.585	0.861	
Waste management	0.826	0.436	0.546	0.627	0.456	0.551	0.738

Statistically significant at p = 0.01, Diagonal numbers refer to $\sqrt{AVE}$

Table 3: Results of hypothesis testing

Hypothesis	Coefficient	t-stat	p-value	Result
H1: Behavior influences waste management	0.439	7.9830	0.000	support
H2: Technology influences waste management	0.111	2.1708	0.000	support
H3: Behavior influences participation	0.474	9.3392	0.000	support
H4: Technology influences participation	0.339	5.9148	0.000	support
H5: Behavior influences technology	0.519	11.8530	0.000	support
H6: Participation influences waste management	0.200	3.3182	0.000	support

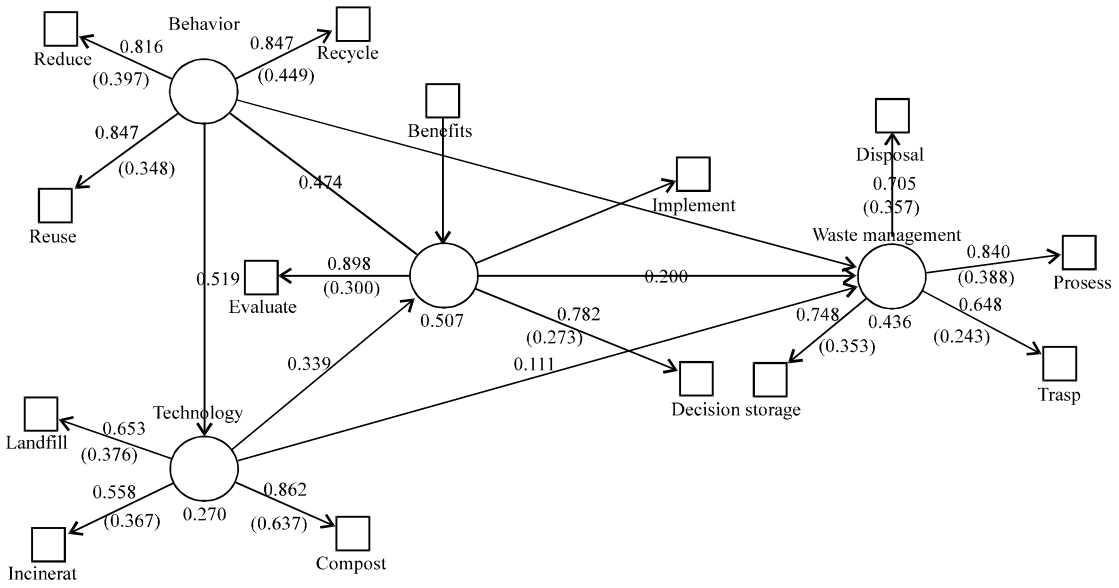

Fig. 1: Final model

H2: Technology utilization affects waste management. The test result found that technology affects waste management with a coefficient of 0.111, a fact validated by the hypothesis significance $p \leq 0.01$

H3: Waste disposal behavior affects people's participation. The test result found that behavior affects participation with a coefficient of 0.474, a fact validated by the hypothesis significance $p \leq 0.01$

H4: Technology utilization affects people's participation. The test result found that technology affects participation with a coefficient of 0.339, a fact validated by the hypothesis significance $p \leq 0.01$

H5: Waste disposal behavior affects technology utilization. The test result found that behavior affects technology with a coefficient of 0.519, a fact validated by the hypothesis significance $p \leq 0.01$

H6: People's participation affects waste management. The test result found that Participation affects waste management with a coefficient of 0.200, a fact validated by the hypothesis significance $p \leq 0.01$

DISCUSSION

It was found that waste disposal behavior has a direct effect on waste management. Populations in developed countries are encouraged to engage in the 3 Rs. as a strategy to establish sustainable waste management. People in Phuket minimally use recycle while reduce and reuse were performed satisfactorily. The findings show that mostly people collect and separate garbage into types such as plastic bottles, used paper or cans to sell for an extra income.

Waste disposal behavior has a direct effect on people's participation as well. The recycling behavior is caused by participation of people with a goal of developing sustainable waste management.

In addition, study findings show that waste behavior has a highly direct effect on technology utilization. People believe that local administrative organization (Phuket city municipality) is

responsible for the technology used for waste management; landfill, incineration and composting, not the people. So, they pay less attention to any type of technology used. Anyway, they want the responsible organization to mainly use landfill and composting to preserve the environment.

The study found that technology utilization has direct effect on people's participation in waste management. The responsibility is solely left on the local administrative organization while local people have minimum role in decision-making, implementation, benefit or evaluation.

People's participation has a direct effect on waste management leading to successful sustainable waste management. People in Phuket participate in all four stages of waste management; decision-making, implementation, benefit and evaluation. The highest rate of participation is in implementation followed by those in benefit and evaluation and the least is in decision-making. However, they expect to participate in every stage equally.

However, technology utilization has a low level of direct effect on waste management, as technology, such as incineration which involves high levels of heat and is utilized by the local government, is not an appropriate method of waste management nor are other technologies that would create toxic pollution and harm people's health and the environment.

CONCLUSION

Waste management in Phuket is largely the responsibility of the local administrative organizations. However, there are clear indicators that the government needs to establish better correlations with the people to create a more efficient waste management system. The government needs to ensure that the people are provided opportunities to be involved as well as encourage the people to rethink their waste disposal behavior to reduce waste generation before it needs to be processed or disposed of by appropriate and environmentally-friendly technology utilization.

Thus, it can be surmised that people's participation, waste disposal behavior and technology utilization in Phuket province's waste management is appropriate and can be used as a model for the local government of other provinces for efficient and sustainable waste management.

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